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Bermudan Cephalopods¹

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The cephalopods reported upon here were collected off Bermuda during the summer of 1948 by an expedition of Chicago Natural History Museum (CNHM) based at the Bermuda Biological Station. The collections were made by means of the Woods Hole Oceanographic Institution's research vessel *Caryn*. A variety of nets was used, none of which were of the closing type. As a result, definite statements as to the depth of capture cannot be made. The depth fished has been calculated as one third of the amount of wire out for those stations not listed by Grey (1955), from which the station list was partly compiled.

A brief résumé of the Bermudan cephalopods is given for the sake of completeness. Since the Bermudas are oceanic islands located far from other land masses, the boundaries have been set to contain that area within a circle whose radius is 200 miles.

I am indebted to Dr. Fritz Haas, Curator of Lower Invertebrates, Chicago Natural History Museum, for permission to study the collections, and for providing useful data. The collection consists of 50 specimens representing 21 species, of which three are new to science. Only three of these species have previously been recorded from Bermuda. This study has been supported by a grant-in-aid from the National Science Foundation (NSF-G-5853) which I gratefully acknowledge.

FORMER RECORDS

Apparently the first record of a cephalopod from the Bermuda Islands was given by Verrill (1880a). He listed three species collected on the beach by G. Brown Goode: *Stenoteuthis pteropus*, *Sepioteuthis sepioidea*, and *Loligo pealei*. In his report of the *Challenger* expedition, which touched at the islands, Hoyle (1886) named a new species of

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Octopus, *O. bermudensis*, from the reefs, and also listed a squid, *Onychia caribaea*, from Station 30, between St. Thomas and the Bermudas, but Peile (1926) states that this station was actually near Bermuda and he includes it in his list. Heilprin (1888) described *Octopus chromatus* from a specimen collected at Flatts, and also reported that *Octopus vulgaris* was seen but not collected. In his monographic revision of the Oegopsida Pfeffer (1912) listed three species from the area: *Onychoteuthis banksi*, *Onychia caribaea* and *Brachio-teuthis riisei*. In the report of the material collected by the United States survey ship *Bache*, Berry (1920) described a new species of cranchiid, *Teuthowenia corona*, from near the islands ($32^{\circ} 29'N.$, $68^{\circ} 22'W.$, 0–100 meters).

A paper published by Peile (1926) contains a short section on cephalopods. He lists nine species: *Spirula australis*, *Loligo pealei*, *Sepioteuthis sepioidea*, *Onychia caribaea*, *Stenoteuthis bartrami*, *S. pteropus*, *Octopus rugosus*, *O. bermudensis* (= *chromatus* Heilprin), and *Argonauta argo* var. *americana* Dall. To this may be added two species described by Joubin (1931, 1935): *Octopodoteuthis danae* and *Egea inermis*.

Two other works must be mentioned, both by Pickford. In 1945 this author published her revision of the littoral octopods of the western Atlantic. Two species are recorded: *Octopus vulgaris* and *O. macropus*. Later, in 1950, in her work on the Vampyromorpha she listed *Vampyroteuthis infernalis* from Bermudan deep waters.

For some years Mr. Louis Mowbray, Curator of the Government Aquarium, Flatts, has sent me small collections of cephalopods from Bermuda. In one of these collections was a number of small loliginids which were identified as *Doryteuthis plei*. This is the first record of this tropical species from the islands. I am not at all certain that the *Loligo pealei* recorded by Verrill did not belong to *Doryteuthis*, as I have never seen *Loligo pealei* among the collections in my possession.

A list of the Bermudan cephalopods follows. All of those species marked with an asterisk are new records for the area, as nearly as can be determined from the literature.

Subclass Coleoidea

Order Sepioidea

Family Spirulidae

1. *Spirula spirula* (Linnaeus)

Order Teuthoidea

Suborder Myopsida

Family Loliginidae

2. *Loligo pealei* Le Sueur
3. *Sepioteuthis sepioidea* (Blainville)
4. **Doryteuthis plei* (Blainville)

Suborder Oegopsida

Family Enoploteuthidae

5. **Abraliopsis morisii* (Verany)
6. **Pyroteuthis margaritifera* (Rüppell)
7. **Pterygoteuthis giardi* Fischer

Family Octopodoteuthidae

8. *Octopodoteuthis danae* Joubin

Family Onychoteuthidae

9. *Onychia caribaea* Le Sueur
10. *Onychoteuthis banksi* (Leach)

Family Bathyteuthidae

11. **Bathyteuthis abyssicola* Hoyle
12. **Ctenopteryx siculus* (Verany)

Family Histiototeuthidae

13. **Calliteuthis celetaria*, n. sp.
14. **Calliteuthis* sp.

Family Mastigoteuthidae

15. **Mastigoteuthis* spp.

Family Ommastrephidae

16. *Ommastrephes pteropus* Steenstrup
17. *O. bartrami* Lesueur

Family Brachioteuthidae

18. *Brachioteuthis riisei* Steenstrup

Family Cranchiidae

19. **Leachia cyclura* Le Sueur
20. **Galiteuthis armata* Joubin
21. **Megalocranchia megalops* (Prosch)
22. **Megalocranchia papillata*, n. sp.
23. *Megalocranchia corona* (Berry)
24. **Carynoteuthis oceanica*, n. sp.
25. *Egea inermis* Joubin
26. **Bathothauma lyromma* Chun

Order Vampyromorpha

27. *Vampyroteuthis infernalis* Chun

Order Octopoda

Family Octopodidae

28. *Octopus vulgaris* Cuvier (= *O. rugosus*)
29. *O. macropus* Risso (= *O. chromatus* Heilprin and *O. bermudensis* Hoyle)

Family Bolitaenidae

30. **Eledonella pygmaea* Verrill
31. **Japetella diaphana* Hoyle

Family Vitreledonellidae

32. **Vitreledonella richardi* Joubin

Family Argonautidae

33. *Argonauta argo* Linnaeus (= var. *americana* Dall)

A few remarks on habitat seem worth while. The only bottom dwellers are *Octopus vulgaris* and *O. macropus*, the "rock" and "grass" scuttles, respectively. They live in shallow water and are both found on the mainland, *vulgaris* from as far north as Long Island Sound, *macropus* from southern Florida and the Bahamas.

All of the loliginids, *Loligo pealei*, *Sepioteuthis sepioidea*, and *Doryteuthis plei*, are coastal species, seldom being found far from land. While *L. pealei* occurs as far north as Cape Cod, *S. sepioidea* and *D. plei* are both tropical species, the former found along the mainland only as far north as Cape Canaveral on the Florida coast and the latter recorded as far north as Sea Island, Georgia (*Pelican* record). They undoubtedly were introduced from the south.

All of the remaining species are inhabitants of the open ocean, occurring far from land. Their occurrence at Bermuda was expected and the list will grow materially as more net collecting is carried out in the vicinity of the islands. A few are truly deep species, as will be noted under the individual records, but most are commonly found in the upper surface, either dwelling there in the young stage or migrating upward to it during the early evening.

SYSTEMATIC SECTION

Family ENOPLOTEUTHIDAE

Abraliopsis morisii (Verany, 1837)

Onychoteuthis Morisii Verany, 1837, Mem. Accad. Torino, 1: 2.

Material.—One male, mantle length 26.5 mm.; CNHM no. 78299; haul 41.

This beautifully preserved specimen has retained its rich reddish brown color, among which the light organs on the ventral surface of the mantle, funnel, head and arms are plainly visible. The right eye-ball is protruding and bears five small round photophores in a row on the ventral surface, the terminal organs about twice as large as the inner three. The right ventral arm is hectocotylized and the penis contains numerous spermatophores.

This species may be easily distinguished from the other Atlantic enoploteuthids by the large, black, swollen three-parted photophores on the distal part of the ventral arms. It is an upper bathypelagic species, occurring from the surface to a depth of about 500 meters.

Pyroteuthis margaritifera (Rüppell, 1844)

Enoploteuthis margaritifera Rüppell, 1844, Intorno ad alcuni cefalopodi del mare di Messina, p. 129.

Material.—One female, mantle length 11.5 mm.; CNHM no. 78300; haul 30.

This is another bathypelagic species, dwelling apparently in the upper 600 meters. It is commonly distributed over the Atlantic in

temperate and warm waters. Development is incomplete in this specimen and for full details Chun's monograph (1910) of the *Valdivia* expedition, with colored plates, is unexcelled.

Pterygioteuthis giardi Fischer, 1896

Pterygioteuthis giardi Fischer, 1896, Jour. Conch., 43: 205.

Material.—One juvenile, mantle length 8.5 mm.; CNHM no. 78301; haul B30.

Only one specimen of this common bathypelagic species was captured. The definitive number of photophores on the eyeball has not yet developed, and the tentacular club is immature in appearance. This species has been exquisitely illustrated by Chun (1910) in the *Valdivia* monograph. It probably lives between the surface and about 500 meters, or near the limit of light penetration.

Family BATHYTEUTHIDAE

Bathyteuthis abyssicola Hoyle, 1885

Bathyteuthis abyssicola Hoyle, 1885, Rep. Sci. Res. Voy. Challenger, 1: 272.

Material.—One juvenile, mantle length 7.0 mm.; CNHM no. 78302; haul 50.

Only one specimen of this widespread species was captured. It is somewhat faded, only the arms retaining the deep reddish color. The light organs, six in number, are present on the base of each of the three upper pairs of arms. They appear as long, oval, dark bodies with light centers.

The characteristic color, the protruding and forward-directed eyes, the separate terminal fins, and the six light organs easily serve to identify this interesting deep sea species. It occupies considerable depths, probably from near the surface to 1500 meters or more.

Ctenopteryx siculus (Verany, 1851)

Sepioteuthis siculus Verany, 1851, Mem. Accad. Torino, 1: 51.

Material.—Two juveniles, mantle length 9.0 and 11.0 mm.; CNHM no. 78303; haul 23.

This species is widely represented in deep hauls and is easily recognized by the peculiar comb-like structure of the fins. In the early larvae the fins are small and terminal, but they begin to grow anteriorly and soon show strong lateral supports and transverse muscle bundles connected by a thin, delicate membrane, the flat surface of

the fins. In almost all cases the membrane is torn between the supports, leaving a curious comb or fringe. In adults the fins attain the full length of the mantle. Although closely related to *Bathyteuthis*, *Ctenopteryx* appears to be limited to the upper 400 meters of the sea.

Family ONYCHOTEUTHIDAE

Onychoteuthis banksi (Leach, 1817)

Loligo banksi Leach, 1817, Zool. Misc., 3: 141.

Material.—One juvenile, mantle length 6.5 mm.; CNHM no. 78304; haul 46. One juvenile, mantle length 11.5 mm.; CNHM no. 78305; haul 30. One juvenile, mantle length 8.0 mm.; CNHM no. 78306; haul 48.

This species of cephalopod, above all others, may be called cosmopolitan. It is known in all oceans from as far north as Hammerfest, Norway, to the Southern Ocean, and is found in nearly all collections. It often "flies" onto the decks of ships at sea. Oceanic in habitat, it is usually found from the surface to about 150 meters. The young may easily be identified from all other squids by the sleek, compact appearance with partially withdrawn head, nearly terminal fins, beyond which projects the sharp, tapered, slightly curving and transparent conus of the gladius, and the dark streak along the dorsal mid-line of the mantle composed of the visible rib of the gladius with a streak of closely set brown chromatophores over it.

Family HISTIOTEUTHIDAE

Calliteuthis celetaria, new species. Figure 73.

A single specimen of this species is available to me. It differs so strikingly from other known species of the genus *Calliteuthis* that it is here referred to a new species.

The *mantle* (fig. 73, *a*) is thick, firm, and more elongate than in most other species of the genus. Its greatest width is at the anterior margin; the sides are somewhat parallel. The posterior end tapers to a blunt point. The anterior margin is slightly produced dorsally and excavated ventrally below the funnel, with sharp lateral angles.

The *fins* are large, longer than half the mantle length, with their greatest width in the posterior third. The notch between the fins is deep, starting at the mantle tip, but the edges of the lobes extend well beyond the mantle.

The *funnel* is small and strong, without a groove and with two dorsal supports. The funnel-mantle locking apparatus is typically calliteuthid, the mantle member crescent-shaped, heavier posteriorly. The funnel organ (fig. 73, *b*) is normal. The

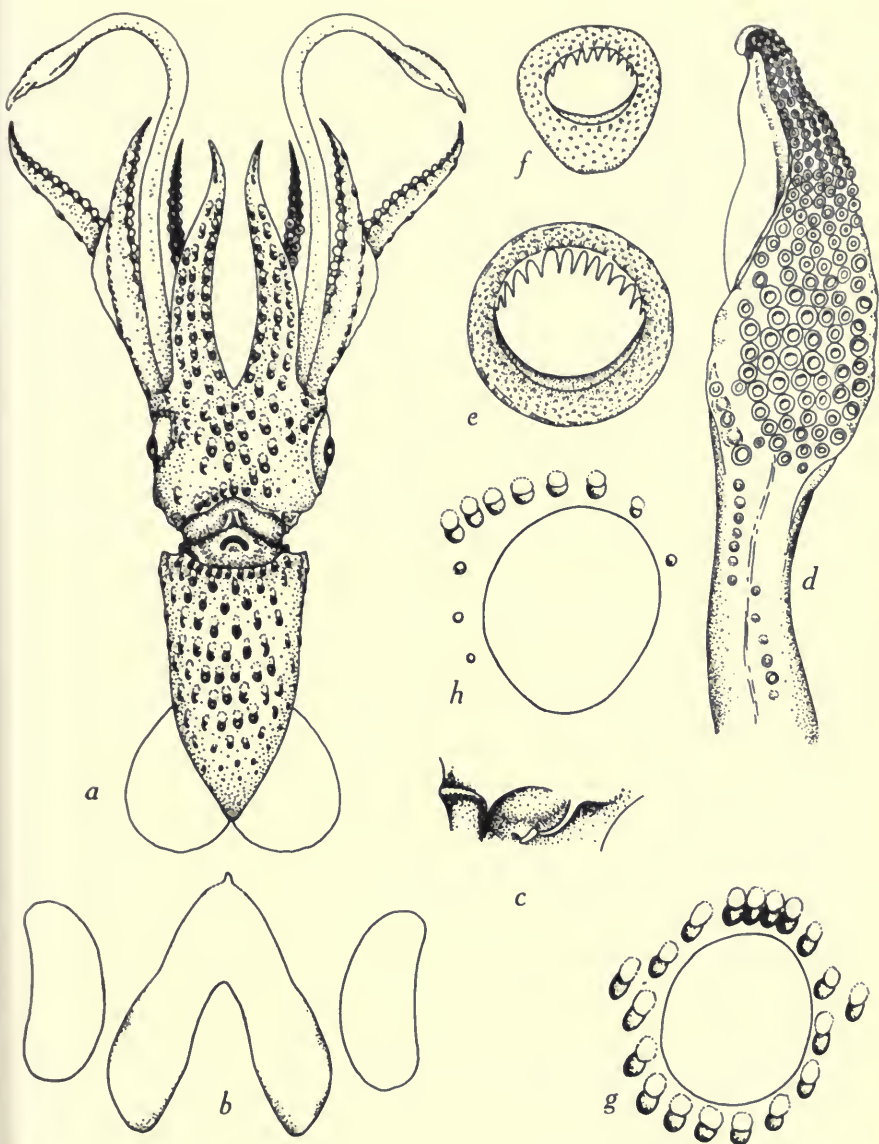


FIG. 73. *Calliteuthis celetaria*, new species. *a*, Ventral view of holotype; mantle length 39.0 mm. *b*, Funnel organ. *c*, Nuchal folds and olfactory crest. *d*, Left tentacular club. *e*, Horny ring of large tentacular sucker. *f*, Horny ring of postero-ventral tentacular sucker. *g*, Light organs around right eye. *h*, Light organs around left eye.

dorsal member is Δ -shaped with long arms and either a pointed apex or a short papilla (damaged). It has no ridges or flaps and is fleshy but not puffy. The ventral pads are long ovals.

The *head* is large, slightly wider than the mantle and flattened dorsally. The left eye is about twice the size of the right eye, with a correspondingly larger eyelid opening. There appears to be no sinus on either eyelid. There are two nuchal folds (fig. 73, c) on each side of the head. The dorsal fold is smoothly curved downward, terminating in a simple point. The ventral fold is also the olfactory crest and turns smoothly upward, terminating posteriorly in a raised bar-like olfactory organ.

The *arms* are long and stout, in the order 3.2.1.4, with arms III and II nearly equal in length. Arms I and II were slightly damaged so that it could not be determined whether there were swimming keels on them or not. On arm III the keel originates just above the base of the arm, broadens to a high ridge at about the middle of the arm, and then decreases to a low ridge. The skin of the ends of the arms was damaged, so it is not known whether the keel extended to the arm tip or not. The arm suckers are biserial, larger than in most other species and nearly equal in size from the base to near the tip, where they diminish in size over a few rows and then abruptly become minute. The horny rings of the suckers are smooth except on arm IV, where a few have several very low round teeth on the distal margin. The suckers of arm IV are about one-third the size of the suckers of the other arms.

The *tentacles* are short and stout, with thick, round stalks and only slightly expanded clubs (fig. 73, d). There is no cleft on the aboral surface of the club. The stalks are slightly flattened on the oral surface with a fine groove in the mid-line. The carpal suckers originate about one club length down the stalk and extend as a single line of suckers and pads from the ventral side across the mid-line to the club and then in a straight line to the dorsal edge of the club. There are about 10 rows of subequal suckers on the club with no real disparity in size either upon the hand or between those of the hand and the attenuated distal portion. The median hand suckers (fig. 73, e) have about 12 or 13 sharp triangular teeth on the distal margin. The proximal margin is smooth. The suckers are bordered by a wide chitinous denticulate collar; on the suckers of the proximal ventral border (fig. 73, f) this tends to become broadened into a plate, giving the suckers of this region a triangular appearance. There is a low protective membrane on each side of the club and an aboral swimming membrane on the distal half of the club.

The *buccal membrane* bears 7 lappets and 7 supports. The web between the arms is vestigial.

The *photophores* are of two types, large and small. On the ventral surface of the mantle the large light organs are numerous, extending over three-fourths of the ventral mantle length. Posterior to the large light organs are a few rows of small photophores. The dorsal surface of the mantle bears numerous small light organs over all the surface except near the posterior end. The dorsal surface of the head bears a few small light organs but the ventral surface bears numerous large photophores with a row of four light organs in the median line excluding the organs of the posterior row. The right eyelid (fig. 73, g) bears a circlet of 17 light organs closely and regularly arranged around the border with a single organ at the mid-point on each side and separated from the series. The left eyelid (fig. 73, h) has a series of 7 large organs in an arc on the anterior border and about 4 or 5 small light organs in two series separated from the others.

There are light organs on all of the arms. On arms I, II and III there is a ventral row of large light organs from the base to near the tip. In addition, obscured by the damaged skin, there is a dorsal row of small light organs, few in number, near the bases of the arms. On arm IV there are three rows of large organs. The ventral row of light organs, consisting of about 10 photophores, extends over about three-fourths of the arm length. The middle row consists of about 10 organs, then a break, and then a group of about 5 light organs diminishing in size to the tip. The dorsal row of light organs consists of 7 photophores, which extend over about half the length of the arm.

The color in alcohol is vinous red with a gold sheen underlying the skin.

Holotype.—Chicago Natural History Museum no. 78308. A female, mantle length 39.0 mm.; from haul 37, 32° 10' N., 34° 45' W., 730–820 meters, 0405–0838 hours, 35-foot otter trawl, August 5, 1948.

Table 1.—Measurements of *Holotype* of *Calliteuthis celetaria*, n. sp.

	mm.		mm.
Total length.....	96.3	Arm I.....	34.8
Mantle length.....	39.0	Arm II.....	36.0
Mantle width.....	19.9	Arm III.....	36.2
Head length.....	19.3	Arm IV.....	32.8
Head width.....	22.0	Tentacle length.....	80.0
Fin length.....	21.0	Club length.....	10.2
Fin width.....	28.0	Sucker diameter (arm II)...	2.0

Discussion.—This new species of *Calliteuthis*, distinct from any of the other known species, is known only from the type from Bermuda. It would be desirable to give diagnostic characters at this time for separation of this species from those previously known, but this must wait until the revision of the genus has been completed. This revision has permitted the clear identification of all of the species of *Calliteuthis* of the Atlantic Ocean based upon distinct and in the main non-variable characters. I must thank my wife, Nancy A. Voss, who is presently engaged in revising the genus, for pointing out the distinctness of the present species and for preparing the detailed illustrations and preliminary descriptions.

The name *celetaria* is derived from the Greek *κελεταριος* (graceful) and is descriptive of the beautiful little animal here described.

Calliteuthis sp.

Material.—One juvenile, mantle length 15.0 mm.; CNHM no. 78307; haul 55.

A second specimen of *Calliteuthis* was found in the collections. It is a juvenile, but sufficient characters are present to distinguish it from the preceding species. The mantle is cone-shaped, with light organs on the anterior two-thirds of the ventral mantle surface con-

sisting of about 3 transverse rows of large organs and 3 rows of small ones. There are a few small ones scattered dorsally.

The head is normal, with the left eye twice as large as the right. There are 17 light organs around the right eye and there is a sinus. The funnel is small and contains a typically shaped calliteuthid funnel organ, but the dorsal member bears a fleshy ridge on each limb which ends posteriorly in a flap. The olfactory organ is a simple papilla. There are no nuchal folds.

The arms are small and subequal, and bear suckers with a number of low rounded teeth on the distal borders. The tentacular club has no aboral cleft. The swimming keel is more than half the club length. The suckers are in about 6 or 7 rows.

At the present time the identity of this specimen must be left in doubt.

Table 2.—Measurements of a Juvenile *Calliteuthis* from Bermuda

	mm.		mm.
Total length.....	49.5	Arm I.....	22.0
Mantle length.....	15.0	Arm II.....	24.1
Head length.....	9.8	Arm III.....	25.0
Head width.....	13.0	Arm IV.....	21.2
Fin length.....	....	Tentacle length.....	36.5
Fin width.....	12.0	Club length.....	5.0

Family MASTIGOTEUTHIDAE

Mastigoteuthis spp.

Material.—One?, mantle length 25.5 mm.; CNHM no. 78309; haul 29. One head with arms; CNHM no. 78310; haul 36.

The two specimens listed above both belong to the genus *Mastigoteuthis*, a peculiar group of deep-dwelling, soft-bodied squids, some of which attain a rather large size. Because of the condition of the specimens, definite identification was not attempted. The complete specimen, lacking only the tentacles, bears no light organs on the body but has two pairs of large light organs on the eyes, one postero-ventral and the other anterior. The end of the body is drawn out into a narrow point beyond the large fins, which occupy about four-fifths of the mantle.

The mutilated specimen consists of only the head, arms and neck, but much of the skin is intact and this bears numerous large, circular photophores on the head and arms.

Family BRACHIOTEUTHIDAE

Brachioteuthis sp.

Material.—One?, mantle length 19.0 mm.; CNHM no. 78311; haul 22.

A single specimen, tentatively identified as a *Brachioteuthis*, is in the collections. It is quite small and badly flexed, and the tentacles are missing. Despite this, the size of the fins and their shape, and the type of locking mechanism point toward this genus. Pfeffer has recorded *Brachioteuthis riisei* from Bermudan waters and the present specimen may belong to this species.

Family CRANCHIIDAE

Subfamily CRANCHIINAE

Leachia cyclura Le Sueur, 1821

Leachia cyclura Le Sueur, 1821, Jour. Acad. Nat. Sci. Philadelphia, 2: 90.

Material.—One female, gravid, mantle length 45.0 mm.; CNHM no. 78312; haul 36. One female, gravid, mantle length 55.0 mm.; CNHM no. 78313; haul 24.

As is typical of this rare species, both specimens lack tentacles, the basal section only remaining as stumps between arms III and IV. The mantle bears no pigmentation, but the head region is strongly colored with reddish brown. The head is small but bears large eyes whose openings could not be determined in either specimen. The eyeballs bear four large light organs on the ventral periphery with another smaller organ halfway between these and the pupil. There

Table 3.—Measurements of Two Specimens of *Leachia cyclura* Le Sueur

	mm.	mm.
Total length.....	67.0	81.0
Mantle length.....	45.0	55.0
Head width.....	9.0	10.0
Fin length.....	11.0	13.0
Fin width.....	22.0	21.0
Arm I.....	4.0	4.5
Arm II.....	9.5	9.0
Arm III.....	15.0	15.0
Arm IV.....	7.5	7.0

is a small, erect olfactory papilla on the ventro-posterior surface of the covering of the eye. The fins are large, terminal, circular, or nearly so, in outline. Both specimens are females with small com-

pact ovaries bearing numerous rather large undeveloped eggs. Most noticeable within the mantle cavity are four large, pigmented bodies, split at the anterior end, lying rather loosely, two lateral, two ventral, on the visceral mass. They appear to be nidamental glands, but are of enormous size in comparison to the remaining viscera, and are united to the mass by only a small section of the posterior end of each. Little is known of the bathymetric range of this species but it is presumed to live between 700 to 1000 meters in depth.

Subfamily TAONIINAE

Galiteuthis armata Joubin, 1898

Galiteuthis armata Joubin, 1898, Ann. Sci. Nat. Zool., 6: 279.

Material.—One, sex indet., mantle length 82.0 mm.; CNHM no. 78314; haul 56. One juvenile, mantle length 58.0 mm.; CNHM no. 78315; haul 22.

The two specimens are in rather poor shape, the mantle greatly contracted and distorted, and no valid measurements can be obtained. This species is only infrequently reported in the literature and much needs to be learned of its developmental history, especially of the adults and maximum size attained. It apparently lives in the upper 1000 meters. In the older stages it has large hooks on the tentacular clubs. Probably its most characteristic feature is the unusually long and finely drawn-out tail, which becomes threadlike toward the extremity.

Megalocranchia papillata, new species. Figure 74.

The *mantle* (fig. 74, *a*) is slender and tubular, perhaps widest near the middle, and tapers to a blunt point posteriorly. It is united to the head dorsally and on each side of the funnel. The mantle wall is thicker and more muscular than is usual in the cranchiids and the gladius does not show through the dorsal wall except for the anterior end which forms a small rhombic area near the edge of the mantle. There is a short dark streak between the anterior bases of the fins. The surface of the mantle is thickly covered with small sharp papillae which are more prominent anteriorly and on the sides and ventral surface of the funnel. They are accompanied by traces of reddish brown chromatophores.

The *fins* (fig. 74, *b*) are very short and broad (1.4×7.0 mm.). They project beyond the end of the mantle and are united to the sides of the gladius point but fused behind it. The fins are irregular in contour.

The *funnel* (fig. 74, *c*) is large and projects far beyond the eyes and reaches to about the basal fourth of the arms. The dorsal member is trifoliate, with a slender pointed papilla in each lobe (fig. 74, *d*). The ventral pads are long and slender and only slightly curved. There is no valve.



FIG. 74. *Megalocranchia papillata*, new species. *a*, Dorsal view of holotype; mantle length 40.0 mm. *b*, Ventral view of fins, showing attachment. *c*, Funnel. *d*, Dorsal member of funnel organ. *e*, Ninth ventral sucker of second left arm. *f*, Oral view of left third arm. *g*, Semi-diagrammatic drawing of spermatophore; length 7.4 mm. *h*, Details of horn and mid-organ of spermatophore; length 1.1 mm.

The *head* is small and somewhat injured. Only the left eye is present. The eye is of moderate size and in the single specimen has no light organ that can be distinguished as such.

The *arms* are short and rather stout. Left I is broken off at the middle and left II and III are missing entirely. The approximate arm order is 1.3.2.4. All arms except IV are keeled on their basal half. They are somewhat compressed with biserial suckers which are bordered by protective membranes. The suckers

of arms I, II and IV are of moderate size, rather closely set and bordered all around their circumference by minute, closely set sharp teeth (fig. 74, *e*). The suckers of III are moderate in size basally but become large very quickly; they have smooth rings. At about the middle of the arm the suckers become much smaller for a pair or two but beyond this they are missing except for a single large sucker near the tip of the arm (fig. 74, *f*). The change in suckers on III probably represents hectocotylyzation and the apparent enlargement of the suckers near the tip may be comparable to that shown by Joubin (1933) for *Teuthowenia* (= *Megalocranchia*) *megalops*, although the suckers show no elongation.

Table 4.—Measurements of Holotype of *Megalocranchia papillata*, n. sp.

	mm.		mm.
Mantle length.....	40.0	Diameter of arm sucker.....	0.8
Mantle width.....	10.5	Arm I.....	12.5
Head width.....	10.0±	Arm II.....	11.3
Fin length.....	1.4	Arm III.....	11.5
Fin width.....	7.0	Arm IV.....	9.0
Eye diameter.....	3.5		

Both *tentacles* are missing; their bases show between arms III and IV and appear symmetrical.

The examination of the viscera showed no points of special interest. However, upon examination of the spermatophores it was found that the structures differed markedly from those so far described. A complete spermatophore is shown in figure 74, *g*, and the details of the horn are shown in figure 74, *h*. In one of these spermatophores, mounted in Canada balsam, the horn is not tightly coiled but is telescoped or accordioned in such a way that it appears jointed. The total length of the spermatophore is 7.4 mm., width 0.4 mm., length of reservoir 4.3 mm., middle section 2.0 mm., mid organ 0.15 mm., length of horn 0.95 mm.

Holotype.—Chicago Natural History Museum no. 78316, one male, in alcohol, mantle length 40.0 mm., from *Caryn* haul 60, 32° 05' N., 64° 38' W., 1500 meters wire out in 3270 meters, 0220–0433 hours, 12-foot ring net, August 28, 1948.

Discussion.—This unique individual differs so greatly from the other cranchiids presently known that it has been deemed necessary to describe it as a new species. Little is known concerning the structure of the spermatophores in the cranchiids, and as these are of significant taxonomic importance it seems advisable to have descriptions of spermatophores tied to indisputably recognizable specimens.

The systematic position of this species is also doubtful. Apparently it is closely related to *Helicocranchia pfefferi* Massy, 1907, and *Helicocranchia beebei* Robson, 1948. Grimpe (1922) considered that Massy's species should be placed in the genus *Teuthowenia* Chun, 1910. By association *H. beebei* should also be placed in this genus. Muus (1956) has shown that *Teuthowenia megalops* Prosch, 1849, is a developmental stage of *Desmoteuthis hyperborea* (Steenstrup) and

that the first has priority, thus changing the name to *Desmoteuthis megalops*, preferring *Desmoteuthis* to *Teuthowenia*. As pointed out by Muus, however, *Desmoteuthis* is a synonym of *Taonius*. In fact, it is an absolute synonym and therefore is not available for use in this case. Berry (1912) has reviewed this situation and pointed out that in all essential details *Megalocranchia* Pfeffer, 1884, is the same as *Desmoteuthis* auct. and is therefore the valid name. Later he (1916) proposed the name *Verrilliteuthis* for reasons that do not now seem valid. Muus (1956) in his discussion of the genera *Taonidium* and *Megalocranchia* states that *Megalocranchia* is identical with *Desmoteuthis*. If this is true, one wonders why he did not then use *Megalocranchia* as the valid generic name.

To return to the present species and its affinities, Muus placed *Helicocranchia pfefferi* Massy, 1907, in synonymy with his *Desmoteuthis megalops*. He gives no reason for this action. If one examines both his figure 4c of a specimen 30 mm. in mantle length and Massy's (1909) plate 3, figure 1, of a specimen with a mantle length of 39 mm., one sees that there is no comparison in fin shape and that Massy's larger specimen has a fin shape comparable to that of much smaller specimens of *Desmoteuthis* (actually *Megalocranchia*). It seems probable that the genus *Helicocranchia* is a synonym of his *Desmoteuthis* but I fail to see the basis for placing *pfefferi* in the synonymy of *megalops*. Perhaps there are other characters which Muus did not elucidate. At present it seems preferable to retain *Helicocranchia* as a subgenus of *Megalocranchia*.

Megalocranchia (Helicocranchia) pfefferi has a smooth mantle, fins which are very narrowly pedunculate but fan-shaped distally and no teeth on the arm sucker rings. *M. (H.) beebei* Robson has non-pedunculate fins which are individually semicircles with scalloped margins, and the sucker rings are unknown. In *M. (H.) papillata* the fins are very slender and non-pedunculate, the arm suckers are finely toothed, there is no light organ on the eye (there is a light organ present in *pfefferi* but not in *beebei*) and the mantle and funnel are strongly papillated.

***Megalocranchia megalops* (Prosch, 1849)**

Owenia megalops Prosch, 1849, K. Dansk. Vid. Selsk. Skr., ser. 2, 1: 64.

Material.—One juvenile, mantle length 26.0 mm.; CNHM no. 78317; haul 27. One juvenile, mantle length 18.0 mm.; CNHM no. 78318; haul 48. One juvenile, mantle length 31.0 mm.; CNHM no. 78319; haul 47. Four juveniles, mantle length 32.0, 22.0, 13.0 and

12.0 mm.; CNHM no. 78320; haul 22. One juvenile, mantle length?, CNHM no. 78321; haul 26. One juvenile, mantle length 19.0 mm.; CNHM no. 78322; haul 58. One juvenile, mantle length 12.0 mm.; CNHM no. 78338; haul 38. One juvenile, mantle length 24.0 mm.; CNHM no. 78323; haul 63. One juvenile, mantle length 17.0 mm.; CNHM no. 78324; haul 52. Three juveniles, mantle length 17.0, 15.0 and 13.0 mm.; CNHM no. 78325; haul 56.

The fifteen specimens listed above seem referable to *Megalocranchia megalops* on the basis of Muus' 1956 paper. While some of them still have terminal fins at a fairly large size, this is not incompatible with our knowledge of larval development. Also in some specimens around 9.0–20.0 mm. in mantle length there is a decided rostrum on the ventral margin of the eyeballs covering a halfmoon-shaped light organ. In the larger specimens the rostrum was lost. Many of the specimens were more slender than is normal, but correspond well with Joubin's (1933) figure of the male of *Teuthowenia* (*Desmoteuthis*) *megalops*. Evidently Muus overlooked this description, for he states (1956, p. 12): "Since none of the adult specimens examined to date have been males, nothing is known on a possible sexual dimorphism."

The species is easily recognized by the lack of tubercle rows at the mantle fusion, absence of a funnel valve, presence of enlarged suckers on arms II and III and semicircular light organs on the eyeballs. The present specimens range from about 300 to 1200 meters in depth.

The generic name of this species has been in a state of confusion for many years. For a review of the biology, morphology and taxonomic status one should consult Muus (1956) and the discussion section of the preceding species.

Carynoteuthis, new genus

A taoniid with sessile eyes which bear two large meandering light organs; funnel with a small valve, the dorsal funnel organ with two large triangular flaps; arm suckers minutely toothed; tentacular suckers toothed; light organs present on the ink sac.

Type species.—*Carynoteuthis oceanica*.

Carynoteuthis oceanica, new species. Figure 75.

Megalocranchia abyssicola Joubin, 1924, Result. Camp. Sci. Monaco, 67: 96.

The mantle (fig. 75, a) forms a slender cone with straight sides, converging to a point posteriorly. It is widest at the anterior margin and is united by a fusion in the nuchal region and on each side of the funnel.

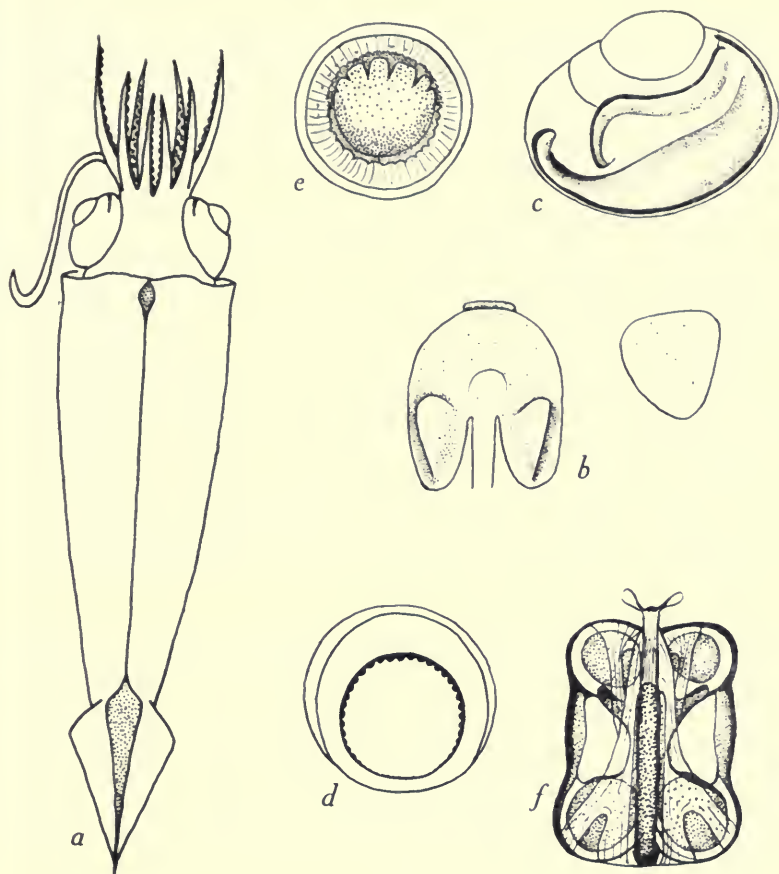


FIG. 75. *Carynoteuthis oceanica*, new genus and species. *a*, Dorsal view of holotype; mantle length 76.0 mm. *b*, Funnel organ. *c*, Right eyeball, ventral view, showing light organs. *d*, Sucker from third left arm. *e*, Sucker from hand portion of tentacular club, inner row. *f*, Details of ventral surface of the liver of the holotype, showing arrangement of light organs.

The *fins* are small, terminal, slender, attached to the posterior end of the gladius and projecting beyond the mantle end for over half their length. They have nearly straight posterior edges and form a long triangle.

The *funnel* is large and projects to about the level of the eyes. It has a U-shaped dorsal funnel organ (fig. 75, *b*) with a large, thin, triangular lappet on each side. The ventral pads are large and nearly oval. There is a broad, nearly straight-edged valve just anterior to the margin of the dorsal funnel organ and nearly covered over by it.

The *head* bears enormous round black eyes which are sessile and about as wide as the mantle. The eyes bear two light organs. Their arrangement is shown in fig-

ure 75, c. In their shape and arrangement they do not agree with the light organ structure as given by Pfeffer for the Taoniinae, although they are probably derived from the basic double halfmoon type. They do not correspond to any as yet described. There is an olfactory organ below and posterior to each eye. It is borne on a long slender stalk and is cup-shaped, somewhat resembling that illustrated by Goodrich for *Megalocranchia abyssicola*. The buccal membrane is seven-pointed and has seven connectives.

The *arms* are in the order 3.4.2.1 and nearly round in cross section. The suckers are biserial with minute round teeth on the horny rings (fig. 75, d). The suckers are somewhat smaller toward the base of the arms but they increase in size, becoming largest about two thirds of the length of the arm; near the tip they become smaller and then are abruptly minute. The suckers are bordered on both sides by a protective membrane consisting of large fleshy trabeculae joined by a rather delicate web.

The *tentacles* are slender, round in cross section and flattened on the oral surface. The clubs are moderately long, little expanded and bordered on each side by a trabeculate membrane. A narrow keel borders the distal half of the club on the dorsal side. There is no distinct carpal cluster but the four rows of suckers continue down the stalk as minute suckers for a distance about equal to the length of the club. The hand suckers (fig. 75, e) are borne on short stalks, and are cupped and bordered by a broad papillate band. The apertures are armed with about 18–20 sharp teeth, large and separate on the distal half, close together and minute proximally.

The mantle was opened and the viscera examined (fig. 75, f). The arrangement of the liver, ink sac and what appear to be four large lenses over a diffused light organ is unusual. The liver is large and fat, oval in outline. On the ventral surface lies a larger rectangular ink sac, traversed ventrally by the rectum, which extends downward posteriorly and then turns along the sac anteriorly, terminating at the anterior edge where the ink sac duct unites with it just posterior to the anus. On each of the four corners of the ink sac is located a large, clear, hollow sphere, easily ruptured, lying over and united with an iridescent layer. There appear to be two of these, one on each side, forming a somewhat saddle-shaped organ. I have remarked nothing like this in the cephalopods which have come to my notice.

Holotype.—Chicago Natural History Museum no. 78326. A female, mantle length 76.0 mm., from *Caryn* haul 61, 32° 08' N., 64° 33' W., 3500 meters of wire out, in 1700 fathoms, 1135 hours, Blake trawl, August 30, 1948.

Paratype.—One female, mantle length 44.0 mm.; CNHM no. 78327; *Caryn* haul 63, 32° 12' N., 64° 36' W., 3000 meters of wire out, in 1300 fathoms, 12-foot ring net, 1243 hours, September 2, 1948.

Discussion.—It is with trepidation that I have erected a new genus to accommodate this species, inasmuch as there is a possibility that it may be the adult of Chun's *Corynomma speculator*. His smallest specimen of 11.0 mm. mantle length was figured, the larger one of 32.0 mm. mantle length was not, and was only incompletely described. We do not know what changes were brought about by growth. My 44.0 mm. specimen is very different from his, and is comparable only

in the presence of a light organ on the liver. It differs in other aspects: the sessile eyes (an adult character?), the differently shaped funnel organ, the presence of a valve, and others. These alone prevent its being placed in *Corynomma*.

Table 5.—Measurements of Type and Paratype of *Carynoteuthis oceanica*, n. sp.

	Holotype mm.	Paratype mm.
Mantle length.....	76.0	44.0
Mantle width.....	23.0	11.0
Head width.....	21.0	11.0
Fin length.....	20.5	11.0
Fin width.....	14.0	8.5
Arm I, length.....	13.0	6.5
Arm II, length.....	16.5	6.5
Arm III, length.....	21.5	11.0
Arm IV, length.....	19.0	10.2
Eye diameter.....	12.0	7.0
Diameter of arm sucker.....	1.2	0.5
Diameter of club sucker.....	0.6	0.4
Tentacle length.....	32.0	23.0
Club length.....	10.0	7.0

In 1924 Joubin described a specimen from off the Azores which he called *Megalocranchia abyssicola* Goodrich, 1896. His description and illustrations conform exactly to the present species. Joubin dismisses the differences between the Azores specimen and Goodrich's Laccadive specimen by stating that Goodrich's description and illustrations were not accurate. However, he did not examine the only specimens, which are in the Calcutta Museum. I have carefully compared my specimens with Goodrich's description and illustration and I am convinced that Joubin's assumption was erroneous. In addition, I requested the curator of the mollusk collections in the Calcutta Museum to re-examine the type, but I was informed that it was in such poor condition that nothing of value could be determined from it. Under these circumstances I feel justified in my original decision that *M. abyssicola* and *Carynoteuthis oceanica* are quite distinct and that Joubin was in error.

From *Desmoteuthis* and its complex, *Teuthowenia* and *Megalocranchia*, it may be separated by its possession of internal light organs and a funnel valve and the shape of the funnel organ. One species in *Megalocranchia* is excepted, *M. abyssicola* Goodrich, 1896, which has a funnel valve. This may possibly belong to *Carynoteuthis*. It is interesting to note that Pfeffer, Chun, and Thiele all state that the funnel valve is lacking in the Cranchiidae, despite Goodrich's state-

ment and illustration and the description by Joubin (1895) of a valve in *Taonius richardi*. The present specimens should dispel this error.

The name *Carynoteuthis* is derived from the R/V *Caryn* and the Greek *τευτης* or squid. The specific name *oceanica* refers to its habitat.

Bathothauma lyromma Chun, 1906

Bathothauma lyromma Chun, 1906, Zool. Anz., 31: 86.

Material.—One female, mantle length 80.0 mm.; CNHM no. 78328; haul 45. One female, mantle length 60.0 mm.; CNHM no. 78329; haul 59. One juvenile, mantle length 36.0 mm.; CNHM no. 78330; haul 39. Three juveniles, mantle length 29.0, 26.0 and 10.0 mm.; CNHM no. 78331; haul 22.

A nice series of specimens from 10.0 to 80.0 mm. in mantle length of this poorly known and weird species is available. I have compared these specimens with a male of 114.0 mm. mantle length from the Philippines and find no essential differences. In the specimens at hand there is a large yellowish chromatophore between the bases of the eyestalks on the dorsal surface of the head stalk, and a row of similar spots along the ventral mid-line of the stalk, which extends outward along the ventral surface of the eyeball. The fins are somewhat rectangular in outline and widely separated from one another, the blunt, round end of the mantle projecting somewhat beyond. The mantle of these creatures may aptly be described as resembling deflated sausage skins, both in shape and consistency.

The availability of such a wide range of sizes lends itself to a survey of the changes in proportions due to growth; the following measurements are given.

Table 6.—Measurements of Six Specimens of *Bathothauma lyromma* Chun
(In millimeters)

Mantle length.....	10.0	26.0	29.0	36.0	60.0	80.0
Mantle width.....	.....	.....	.....	.....	.....	.....
Head width.....	12.5	30.0	21.0	33.0	39.0	52.0
Fin length.....	.....	5.0	6.0	7.0	9.5	10.5
Fin width.....	.....	5.0	5.5	5.0	9.0	10.0
Arm I.....	0.8	2.4	2.5	2.0	6.5	8.0
Arm II.....	0.8	3.0	3.3	2.3	8.5	10.0
Arm III.....	0.8	3.1	3.6	2.3	9.5	11.0
Arm IV.....	0.8	3.2	3.0	2.8	8.5	10.0
Tentacle length.....	14.0	41.0	58.0	36.0	61.0	62.0
Club length.....	.....	.....	.....	.....	.....	.....
Head stalk length.....	8.0	18.0	13.0	16.5	18.0	21.5
Eye stalk length.....	6.0	13.0	11.5	13.0	17.5	22.0

From the data presented in the table it can be seen that in the younger specimens the mantle is rather short and wide (mantle width could not be measured because of the flattened condition of the mantle and extreme wrinkling), with long slender head stalks, long tentacles and short arms. Growth of the head stalk is very slow in comparison to mantle growth so that the general appearance in the adult is of a long tubular body, short stalk and only comparatively long tentacles. Arm growth does not seem to be at the same rate as the mantle, for under 36 mm. the arms are very short, but between 36 and 60 mm. the arms greatly increase in length, becoming long and slender. Only fin growth seems to remain at the same rate throughout. The depth range of this species is not known since all records are from open nets, but one may conjecture that it occurs at 1000 meters and above.

OCTOPODA

Family OCTOPODIDAE

?*Octopus vulgaris* Cuvier, 1797

Octopus vulgaris Cuvier, 1797, Tabl. Elem. l'Hist. Nat. Anim., p. 380.

Material.—Two juveniles, mantle length 7.0 and 8.0 mm.; haul 37.

In the same haul with some specimens of *Japetella diaphana* were two small octopods. While not in good shape, part of the head pigmentation was present. Conceivably, these two specimens entered the net in the upper layers. Of the two species of octopus known to occur in Bermuda, *O. macropus* and *O. vulgaris*, both spawn small eggs and have planktonic larvae. The former has a long, slender, pointed mantle, while the latter has a round, sac-like mantle. The present specimens correspond to *O. vulgaris* and are tentatively placed in this species.

Family BOLITAENIDAE

Eledonella pygmaea Verrill, 1884

Eledonella pygmaea Verrill, 1884, Trans. Connecticut Acad. Sci., 6, (1), p. 145.

Material.—Two females, mantle length 38.0 and 31.5 mm.; CNHM no. 78332; haul 57. One male, mantle length 25.0 mm.; CNHM no. 78333; haul 30.

Thore's (1949) masterful treatment of this species leaves little to be said of interest concerning these specimens. The females are richly covered with dark brown chromatophores, the head and web

region being darker than the body. The male, conversely, is rather light and transparent, with little pigmentation. The eyes are small, the suckers are rather large and are set one or two diameters apart and rather well embedded in the tissue. The male has the third right arm modified into a hectocotylus, the distal portion bearing four immense suckers, the largest 3.2 mm. in diameter, the second 3.0 mm., the third 2.0 mm., and the terminal one 1.0 mm. Thore states that there are 6–8 small suckers but I found only one. As Thore first reported from the *Dana* material, there is a distinct ligulus on the distal portion. In the present specimen, it varies somewhat from the shape shown by him and the ligula is more of a typical octopodid spoon shape. It is possible that the discrepancies noted in the shape of the ligula and the reduced number of small suckers beyond the enlarged three is a function of growth and represents immaturity. Thore has shown that this species is truly bathypelagic, the young occurring just beneath the discontinuity layer from 100 to 200 meters, and that no specimens over 35.0 mm. in mantle length occur in less than 333 meters; they go down to 2500 meters, with an average distance from the bottom of 3038 meters and never less than 700 meters.

Japetella diaphana Hoyle, 1885

Japetella diaphana Hoyle, 1885, Rep. Sci. Res. Voy. Challenger, 1: 232.

Material.—One female, mantle length 14.0 mm.; CNHM no. 78334; haul 37.

This species has also been revised by Thore (l.c.). It is a common and widely distributed species, easily recognized by the close-set urn-shaped suckers and rather large laterally directed eyes. The present specimen is evidently a juvenile and measurements could not be taken. Thore has given a detailed account of his calculations concerning the depths at which this species lives. According to him, the young are found at about 200 meters, just below the discontinuity layer, from whence they migrate downward, adults over 40.0 mm. living below 333 meters and concentrated at 1750 and 2500 meters.

Family VITRELEDONELLIDAE

Vitreledonella richardi Joubin, 1918

Vitreledonella richardi Joubin, 1918, Bull. Inst. Oceanogr. Monaco, no. 340, p. 1.

Material.—One male, mantle length 34.0 mm.; CNHM no. 78335; haul B16.

This species has been so well studied and discussed by Thore that nothing new can be added here. The animal is in rather poor condition and very flaccid, so that accurate measurements are impossible, but excellent data have been given by Thore. The species may easily be distinguished by its clear gelatinous appearance, the small, rectangular eyes, and long, slender, pointed liver. The left third arm is hectocotylized on the distal portion by a marked reduction in size of the suckers and dense crowding, terminating on the tip by a distal spoon-shaped ligula. According to Thore the young of this species hatch out at a depth below 1000 meters but grow to near adulthood just below the discontinuity layer and thence move back downward, living out their life between 1000 meters and 1750 meters.

Family ARGONAUTIDAE

Argonauta argo Linnaeus, 1758

Argonauta argo Linnaeus, 1758, Syst. Nat., ed. 10, p. 708.

Material.—One female with shell, ventral mantle length 18.5 mm.; CNHM no. 78336; haul 22. Two females, ventral mantle length 7.0 and 6.5 mm.; CNHM no. 78337; haul 48.

The two small specimens are very immature, the larger one bearing a shell or egg case. This is a very common species with a wide range. The vertical range is not known but certainly it is restricted to the upper layers, rather than at the depth the net was fishing. It has been well figured by Chun (1910) from the living animal.

TABLE 7.—STATION DATA LIST

Haul number	Date	Time	N. Lat.	W. Long.	Depth of haul, meters	Meters of wire out	Bottom depth, meters	Gear
16B	7/15	0055-0425	32° 11.7'	64° 44.5'	730-820	1500	2140	60-ft. otter trawl
22	7/20	2230-0435	32° 10.7'	64° 32.5'	730-820	2500	3200	7-ft. ring net
23	7/23	0050-0355	32° 05.5'	65° 20'	400-450	1500	4390	
24	7/23	1515-?	32° 05'	65° 20'	1000-1100	2500	4390	35-ft. otter trawl
26	7/24	0055-0325	32° 08'	65° 12'	590-660	2000	3840-3932	7-ft. ring net
27	7/27	1735-0030	32° 12'	64° 38.5'	1280-1370	3000	2286	
29	7/28	1935-0119	31° 55'	65° 00.7'	1000-1100	2500	3660	35-ft. otter trawl
30B	7/29	0230-0725	32° 00'	64° 51.7'	1000-1100	2500	3660	
36	8/4	2155-0320	32° 13'	64° 34.5'	1000-1100	2500	2560	
37	8/5	0405-0838	32° 10'	64° 45'	730-820	2000	2195	
39	8/7	0335-0510	32° 10'	64° 38'	200	1000	2560	7-ft. ring net
41	8/12	2150-0045	32° 12.5'	64° 35.5'	500-550	1500	2560	80-ft. otter trawl
45	8/16	2205-0030	32° 14'	64° 35.5'	ca. 2000?	2000	2378	12-ft. ring net
46	8/17	0055-0420	32° 11.5'	64° 36'	730-820	2000	2560	
47	8/17	2114-0040	32° 15'	64° 35'	ca. 2000?	2500	2000	
48	8/18	0105-0340	32° 12.6'	64° 35.5'	1500	3500	2470	

TABLE 7.—STATION DATA LIST (continued)

Haul number	Date	Time	N. Lat.	W. Long.	Depth of haul, meters	Meters of wire out	Bottom depth, meters	Gear
50	8/20	0927-1500	32° 08.2'	64° 33'	3100	3500	3100	7-ft. ring net
52	8/23	0900-1454	32° 14.1'	64° 35.8'	1800?	3500	2000	12-ft. ring net
55	8/25	1850-2200	32° 12.7'	64° 35.2'	730-820	2000	2378	75-ft. otter trawl
56	8/25	2218-0223	32° 07'	64° 37'	260-275	1000	2744	12-ft. ring net
57	8/26	1926-2315	32° 13.3'	64° 37'	730-820	2000	1829	
58	8/26	2345-0330	32° 09'	64° 36'	260-275	1000	2650	
59	8/27	2000-0145	32° 15'	64° 36'	1370-1460	3500	2000	
60	8/28	0220-0433	32° 05'	64° 38'	500-550	1500	3270	Blake trawl
61	8/30	1135-?	32° 08'	64° 33'	ca. 3100	3500	3100	
63	9/2	1243-1630	32° 12'	64° 36'	1280-1370	3000	2378	12-ft. ring net

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